

EXPANSION JOINT FOR STRUCTURAL SLABS

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FIELD OF THE INVENTION

This invention relates generally to expansion joints. More particularly, it relates to an expansion joint for use in connecting structural slabs, such as in airfield runways, industrial flooring or parking structures. However, the expansion joint design disclosed herein could also be used for connecting structural slabs on bridges or highways and even in buildings.

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BACKGROUND OF THE INVENTION

Building structures often incorporate expansion joints to accommodate the movement of structural elements, as a result of temperature changes or seismic activity. In order to prevent moisture from entering expansion joints, it is necessary to protect the joints with a weather proof cover.

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A durable, yet flexible joint between structural slabs, such as concrete slabs or the like, is desirable. Additionally, a flexible joint which is waterproof is advantageous to prevent water from getting under the slabs. For example, in a bridge environment, a waterproof expansion joint retards the rusting of bridges. A waterproof joint is also desirable in a roadway environment to keep various corrosives, such as roadway salt, fuel or oil, from passing through the joint.

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As mentioned, expansion joints, accommodate movement of structural slabs or blocks due to, e.g., weather conditions or seismic activity. They also transmit forces between the structural members. Various types of expansion joints are known in the art. One disadvantage of many known expansion joints is that they are typically recessed somewhat from the abutting surfaces, so that when a vehicle passes thereover, a slight dip is felt. In the course of time, dirt and debris fill the recess of the joint and accelerate its deterioration. Also, if the joint becomes unsealed at any location, then dirt and debris become lodged in that unsealed portion of the joint and further tear the joint

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apart. Thus, the joint deteriorates further and more and more dirt and debris become lodged in the unsealed portions of the joint.

Sealing of expansion joints is required to prevent water containing, e.g., salt or other substances detrimental to the concrete from penetrating, 5 leaching the concrete and damaging the reinforcement bars, if any, in the concrete. Moreover, should water leakage occur at a joint, the PH of the water can change through contact with the concrete, or salt or the like could damage underlying materials. For example, in a parking garage, dripping water could damage the paint of cars located in the deck below the leaky 10 expansion joint. Further, infiltrating water could cause frost erosion and crack formation in the concrete blocks. Thus, in order to be durable, a joint must be tight and must be able to withstand mechanical influences of various kinds, as well as considerable pressure differentials.

Accordingly, it has been considered desirable to develop a new and 15 improved expansion joint which would overcome the foregoing difficulties and others, while providing better and more advantageous overall results.

BRIEF SUMMARY OF THE INVENTION

According to one embodiment of the present invention, an expansion 20 joint includes a first mounting element and a second mounting element spaced from the first mounting element. A membrane having opposed side edges extends between the first and second mounting elements. A means for securing the opposed side edges of the membrane to a respective one of the first and second mounting elements is provided. A layer of a sealant material 25 is located between the first and second mounting elements. A resilient body is located between the first and second mounting elements. The resilient body is positioned between the membrane and the layer of sealant material.

According to another embodiment of the present invention, an expansion joint is provided for positioning between adjacent structural slabs of 30 concrete for use in roads bridges or buildings. The expansion joint includes a first metal plate, a second metal plate spaced from the first metal plate and a membrane positioned between the first and second metal plates. The membrane has opposed side edges. A means for securing the opposed side edges of the membrane to a respective one of the first and second metal

plates is provided. A layer of a sealant material is disposed between the first and second metal plates. A resilient body is located between the first and second metal plates. The resilient body is positioned between the layer of sealant material and the membrane.

5 Further aspects of the present invention will be described in the detailed specification provided hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may take physical form in certain parts and arrangements of parts, preferred embodiments of which will be described in
10 detail in this specification and illustrated in the accompanying drawings which form a part hereof and wherein:

FIGURE 1 is a perspective view of a first embodiment of an expansion joint according to the present invention;

FIGURE 2A is a front elevational view of the expansion joint of
15 FIGURE 1 in an unexpanded, relaxed state;

FIGURE 2B is a front elevational view of the expansion joint of FIGURE 2A in an expanded state;

FIGURE 3A is a front elevational view of an expansion joint according to a second embodiment of the present invention;

20 FIGURE 3B is a perspective view of the expansion joint of FIGURE 3A;

FIGURE 3C is a side elevational view of the expansion joint of FIGURE 3A;

FIGURE 4A is a front elevational view of an anchor member of an expansion joint according to a third embodiment of the present invention;

25 FIGURE 4B is a front elevational view a partially assembled expansion joint employing the anchor of FIGURE 4A; and,

FIGURE 4C is a front elevational view of a fully assembled expansion joint employing the anchor of FIGURE 4A, and shown in an expanded condition;

30 FIGURE 5A is a front elevational view of an expansion joint according to a further embodiment of the present invention shown in an unexpanded state;

FIGURE 5B is a front elevational view of the expansion joint of FIGURE 5A illustrated in an expanded state;

FIGURE 6 is a front elevational view of a portion of the expansion joint of FIGURE 5A; and,

FIGURE 7 is a perspective view of two types of mounting elements which can be employed in expansion joints used in a bridge design.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein the showings are for purposes of illustrating preferred embodiments of the invention only and not for purposes of limiting same, FIGURE 1 shows an expansion joint A between
10 two structural slabs 10 of concrete or a like material. The structural slabs can be sections of a roadway, a parking structure, a bridge or the like. Also, the slabs could be elements of a building or the like structure employing concrete. Such a structural slab 10 can neither be initially provided with a groove 12 or, during renovation, such a groove can be cut into facing walls 14 at the
15 interface between two adjacent slabs.

Positioned in the groove 12 in each of the slabs 10 is a respective mounting element. More specifically, a first mounting element 20 is located in a groove 14 in the first structural slab 10 and a similar second mounting element 22 is located in the groove 14 in the second structural slab 10. It is
20 evident from FIGURE 1 that the two mounting elements are spaced from each other. In one embodiment, the mounting elements can comprise flat rectangular bars, which can be made from any suitable type of conventional metallic material. Alternatively, the mounting elements can be made from a material which comprises rubber or plastic. With reference now to FIGURE
25 2A, each of the mounting elements comprises a bottom end 24, a top end 26 an inner face 28 and an outer face 30. Extending between the two mounting elements 20 and 22 is a membrane 40. The membrane comprises a first side edge 42 located adjacent the first mounting element 20 and a second side edge 44 located adjacent the second mounting element 22. Also, the
30 membrane includes a lower face 46 and an upper face 48.

One means 50 for securing the membrane 40 to the pair of mounting elements 20 and 22 comprises the use of first and second bars 52 and 54 as illustrated in FIGURE 2A. To this end, the bars are secured by suitable conventional fasteners 56 to the respective mounting elements in such a way

that the side edges 42 and 44 of the membrane are trapped between a respective one of the mounting elements and of the bars. The bars can also be rectangular elongated plates made of a suitable conventional metal, if so desired. Typically, the membrane is attached in an approximately vertical
5 orientation to the mounting elements.

The membrane, which is a sealing membrane, is meant to prevent fluids from leaking into the joint between the adjacent slabs 10. It can comprise a known non-plasticized chlorinated polyethylene, a known water resistant fabric, such as a non-woven fabric coated with a polymer, a
10 conventional neoprene rubber or a Hypalon material purchased from Sika under the trademark COMBIFLEX. The COMBIFLEX material can be obtained from Sika Corporation 201 Polito Avenue, Lyndhurst, New Jersey 07071. The membrane can have the thickness on the order of approximately 1.2 to 2 mm. While the membrane needs to be flexible, it should not be
15 expandable or stretchable.

Supported on the membrane 40 is a resilient body 70. In one embodiment, the resilient body can comprise a relatively round elongated mass of a material which can be made of a closed cell cross linked polyethylene with a flame retardant, if so desired. One type of closed cell
20 cross linked polyethylene with flame retardant is the material sold under the trade designation LD45FR by Zote Foams Inc., 55 Precision Drive, Walton, Kentucky 41094. Alternatively, the resilient body can comprise a cell rubber structure.

It is apparent from FIGURE 2A that the resilient body 70 is supported in
25 a "saddle" formed by the membrane 40 as it is mounted between the first and second mounting elements 20 and 22. Since the resilient body 70' is relatively stiff, the whole prefabricated joint construction has to be compressed to fit into the groove structure defined between the adjacent slabs. After the resilient body 70 has been placed on the membrane between
30 the two mounting elements, a sealant material 80 is then layered atop the resilient body so as to cover the space between the first and second mounting elements. The sealant can also be poured and cured in a shop or industrial facility before the joint is installed between the structural slabs. The sealant

material 80 can be a self-leveling material such as a conventional low modulus silicone or a known polyurethane.

With reference again to FIGURE 1, an inward force, as illustrated by arrow 86, is exerted on the resilient body 70 and the sealant material 80 during installation of the expansion joint between the adjacent structural slabs 10. The slabs can be coated with a known epoxy adhesive adjacent the location of the expansion joint before installation thereof. The inward force is counterbalanced by an outward force 88 of the resilient body. During expansion of the joint, as illustrated in Figure 2B, an expansion force 90 pulls the mounting elements 20 and 22 away from each other as the structural slabs shift away from each other. At the same time, the membrane 40 is drawn more tautly between the two mounting elements. As a result, an upward force 92 is exerted by the membrane on the resilient body 70 supported thereon.

It is noted that the resilient body distorts and takes on a more oval shape instead of the relatively rounder shape in its original installation condition. The upward movement of the membrane 40 and the resilient body 70 counterbalances the tendency of the sealant material 80 to assume a concave condition, as the two mounting elements 20 and 22 are moved away from each other. Thus, during expansion, the sealing membrane 40 will create an upward pressure as shown by arrow 92 towards the resilient body 70 and the resilient body provides a support for the stretched and weakened joint sealant material 80.

Another means for securing the membrane to the adjacent mounting elements is disclosed in FIGURES 3A - 3C. In this embodiment, like components are identified by like numerals with a primed (') suffix and new components are identified by new numerals. With reference now to Figure 3B, a means for securing 100 is comprised of an adhesive layer 102 positioned between a first mounting element 20' and a first side edge 42' of a membrane 40'. Similarly, a corresponding adhesive layer (not visible) is positioned between the second mounting element 22' and the adjacent second side edge 44' of the membrane 40'. As in the first embodiment, a resilient body 70' is supported by the membrane 40'. Thereafter, a layer of sealant material 80' is deposited above the resilient body 70'.

Once in place, the resilient body 70' creates an outward pressure towards the two side edges 42' and 44' of the membrane 40', since the resilient body is relatively stiff. This promotes the bonding of the adhesive layer 102, while curing. In one embodiment, the adhesive layer can comprise
5 a conventional epoxy material. It is noted that the membrane is adhesively secured in a downward direction in order to achieve more room between the two mounting elements for the sealant material 80'.

With reference now to FIGURE 3C, an end portion 104 of the membrane can extend out beyond the first and second mounting elements
10 20', 22' so as to overlap the adjacent end of another section of membrane. It should be appreciated that in many environments relatively long lengths of membrane and mounting elements are disposed adjacent each other. In this way, waterproofing is assured in a long joint. In other words, through the use of overlapping sections of the membrane 40' leakage of water or another fluid
15 into the gap between the adjacent structural slabs is hindered.

With reference now to FIGURES 4A - 4C, another embodiment of an expansion joint according to the present invention is there illustrated. In this embodiment, a first mounting element 120 is spaced from a second mounting element 122. Each of the two mounting elements includes a bottom end 124,
20 a top end 126, an inner face 128 and an outer face 130. However, in this embodiment, an anchor 132 is secured to the outer face 130 of each of the mounting elements 120 and 122. The anchor can comprise a stem 133 having a first portion 134 and a second portion 136, which is angled in relation to the first portion. Thus, a bent stem is provided. Disposed at the distal end
25 of the second portion 136 is a head 138 of the anchor. Such an anchor will serve to secure the mounting element to the structural slab. In this embodiment, the concrete of the slab would be poured after the mounting element is positioned, so that the anchor is covered by the concrete of the slab.

30 A membrane 140 is positioned between the adjacent first and second mounting elements 120 and 122. The membrane includes a first side edge 142, which is disposed adjacent the first mounting element 120, and a second side edge 144 disposed adjacent the second mounting element 122. The membrane includes a lower face 146 and an upper face 148. In this

embodiment, a means for securing 150 comprises a first bar 152 and a second bar 154. Each of these is secured by a respective fastener 156 to the adjacent mounting element.

5 The fastener 156 can comprise a threaded stem 158 and a head 160 disposed at a proximal end of the stem. A distal end 162 of the stem can be fastened to the respective mounting bar 152, 154. The stem extends through a suitable aperture 164 in the respective mounting element 120, 122. Threadedly mounted on the stem 158 is a suitable nut 166. On the job site, the sealing membrane 140 is mounted on each side from above. Then, the
10 respective nuts 166 are tightened in order to mechanically fasten the opposed side edges 142, 144 of the sealing membrane in place between the respective mounting elements and the respective bars. In other words, the smaller inner bars 152 and 154 will be pressed into the heavier and larger mounting elements 120 and 122. As in the previous embodiment, the mounting
15 elements 120 and 122 and bars 152 and 154 can be made of a suitable conventional metal.

FIGURE 6 illustrates the process of installation of the membrane 140 between the adjacent mounting elements 120 and 122. Arrows 168 illustrate the process of tightening the nuts 166 on the stems 158 of the fasteners.

20 In this embodiment, a resilient body 170 takes the form of a T-shaped member. The resilient body comprises a stem 172 having a first end 174. Extending from the first end is a first wing 178 having a tip 179 and a second wing 180 having a tip 181. Extending from the second end 176 of the stem are a first protrusion 182 and a second protrusion 184. The pair of wings 178
25 and 180 form a top contact surface 186 for the resilient body 170. Similarly, the pair of protrusions 182 and 184 form a bottom contact surface 188 for the resilient body 170.

In use, as illustrated in FIGURE 4B, the resilient body is compressed during installation such that the tips of the wings rest on the bars 152 and 154.
30 At this time, while the resilient body 170 is in its compressed condition, the bottom contact surface 188 is spaced away from the upper face 148 of the membrane 140. At this time, a suitable sealant material 190 (FIGURE 4C) is deposited atop the resilient body 170. In this embodiment, the top contact

surface 186 of the resilient body forms a barrier preventing downward flow of the sealing material 190 past the resilient body.

With reference now to FIGURE 4C, when an expansion force, as illustrated by arrow 192, is exerted on the expansion joint, an upward force 194 is exerted by the membrane 140 such that the membrane upper face 148 contacts the bottom contact surface 188 of the resilient body 170. This will push the resilient body 170 somewhat upwardly to provide support for the sealing material 190, establishing a support for the upper stretched and weakened sealant material.

With reference now to FIGURES 5A and 5B, another embodiment of the present invention is there illustrated. In this embodiment, like components are identified by like numerals with a primed (') suffix and new components are identified by new numerals. Disposed between a pair of adjacent mounting elements 120' and 122' is a membrane 140'. The membrane supports a resilient body 200. Disposed above the resilient body is a layer of a sealing material 190'. When an expansion force, such as is denoted by the arrow 192', pulls the mounting elements 120' and 122' away from each other, an upward force, as denoted by the arrow 194' is exerted on the membrane 140'.

The resilient body 200 can comprise a relatively round elongated mass of a material which can be made of a closed cell cross linked polyethylene with a flame retardant, if so desired. One type of closed cell cross linked polyethylene with flame retardant is the material sold under the trade designation LD45FR by Zote Foams Inc., 55 Precision Drive, Walton, Kentucky 41094. Alternatively, the resilient body can comprise a cell rubber structure.

With reference now to FIGURE 7, a mounting member with several additional features is illustrated. In this embodiment, like components are identified by like numerals with a double primed (") suffix and new components are identified by new numerals. A mounting element 120" includes an anchor 132". Spaced from the anchor is an angle 210 which can be suitably secured to the mounting element, such as by a weld joint. The angle comprises a vertical plate 212 and a horizontal plate 214. Disposed in the horizontal plate is a threaded opening 216. Selectively mounted in the

threaded opening is a suitable bolt 218. The purpose for the bolt is to allow a leveling of the mounting element 120' in relation to the surface of the structural concrete of the slab (not illustrated).

Another type of mounting member 220 is also illustrated in FIGURE 7.

5 In this mounting member, a flange 230 is disposed at an upper end. The flange can have one or more apertures or holes 232 extending therethrough. These prevent air pockets and provide extra grip in the concrete. Moreover, they may prevent spalling or cracks near each side of the joint, between the pair of structural concrete elements.

10 The invention has been described with reference to several preferred embodiments, obviously, modifications and alterations will occur to others upon the reading and understanding of this specification. It is intended to include all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.